



Prevalence and Intensity of Endoparasites in Ribbonfish (*Trichiurus lepturus*) from (Lamongan) and Tamperan (Pacitan) Fish Landing Sites (TPI)

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Abstract: Parasitic infections in marine fish pose economic and public health risks, particularly when zoonotic species are involved. Ribbonfish (*Trichiurus lepturus*), a commercially important species in Indonesia, is highly susceptible to endoparasites that may reduce fish quality and threaten human consumers. This study aimed to identify the types, prevalence, and intensity of endoparasites infecting ribbonfish landed at Paciran (Lamongan) and Tamperan (Pacitan). A total of 56 fish samples were examined through necropsy and microscopic observation of internal organs. Two nematode species, *Anisakis* sp. and *Camallanus* sp., were detected in the intestine, stomach, and muscle tissues. Prevalence was 0.2% at Paciran and 0.4% at Tamperan, while intensity reached 1.3 and 1.9 ind/individual, respectively. Infected fish were typically larger, with body weights ranging from 100–400 g and lengths of 60–80 cm, and often contained undigested small fish and crustaceans that may serve as intermediate hosts. Although infection levels were classified as low, the detection of zoonotic *Anisakis* sp. underscores the need for continued monitoring to prevent potential health risks and safeguard fishery resources.

Introduction

Parasitic infections in marine fish pose significant threats to both fisheries sustainability and public health. Ribbonfish (*Trichiuridae*), a commercially valuable demersal species widely distributed in Indonesian waters, represents an important fishery commodity for domestic consumption and international trade (1). However, endoparasites such as *Anisakis* spp. and *Camallanus* spp. are frequently reported in demersal fish, including ribbonfish, and can compromise fish quality, reduce market value, and act as potential zoonotic agents (2). Previous studies have reported high prevalence rates of parasitic infections in marine fishes across several Indonesian fish landing sites, underscoring the urgent need for systematic monitoring of fish health status to ensure product safety and sustainability (3).

The increasing global demand for ribbonfish, particularly from East Asian countries, has heightened the need for stringent quality control measures (4). According to the Indonesian Ministry of Marine Affairs and Fisheries (KKP), fishery products exported internationally must be accompanied by a health certificate (SKIPP/Health Certificate for Fish and Fish Products) confirming they are free from quarantine-related pathogenic infections, in compliance with international quality and safety standards. Despite these regulations, comprehensive data on the prevalence and intensity of endoparasite infections in ribbonfish from key

fish landing sites in Indonesia remain limited (5). Moreover, infection dynamics may vary according to ecological conditions, fishing grounds, and handling practices, creating additional challenges in disease prevention and control. The lack of systematic surveillance may expose consumers to health risks and fishers to economic losses.

To address this gap, the present study investigates the prevalence and intensity of endoparasites in ribbonfish landed at Fish Landing Sites (TPI), namely Paciran in Lamongan (Java Sea) and Tamperan in Pacitan (Indian Ocean). By employing purposive sampling and necropsy examination of internal organs, this study provides baseline epidemiological data on endoparasite infection in ribbonfish from two ecologically distinct fishing grounds. The findings are expected to contribute to improved fish health management, food safety assurance, and the sustainable utilization of marine resources.

Methodology

Study Design and Rationale

This study employed a cross-sectional survey design to determine the prevalence and intensity of endoparasite infections in ribbonfish landed at Fish Landing Sites (TPI) in Paciran, Lamongan (Java Sea) and Tamperan, Pacitan (Indian Ocean). These two sites were selected because they represent ecologically distinct fishing grounds that allow

comparison of infection dynamics under different marine environments.

Sampling Strategy and Population

Fish samples were collected between May and July 2022 through purposive sampling. Random sampling was not feasible because ribbonfish were landed in mixed catches and were not separated by species during auction transactions, so random withdrawal would have interfered with the commercial selling process. Approximately 10% of the daily ribbonfish catch landed at each TPI was obtained, resulting in a total of 56 specimens ($n = 27$ from Paciran and $n = 29$ from Tamperan). Only freshly landed individuals free from visible physical damage were included. Total body length (cm) and weight (g) were measured prior to necropsy.

Materials and Examination Procedures

Parasitological examinations were conducted at the Integrated Laboratory of Universitas Islam Negeri Sunan Ampel Surabaya. Dissection instruments (scalpels, scissors, forceps), Petri dishes, and compound microscopes (40 $\times$ –400 $\times$) were used. Each specimen was dissected aseptically, and internal organs including the stomach, intestines, liver, kidneys and muscle tissues were examined for endoparasites.

Tissue digestion was conducted using 0.5% pepsin-HCl solution at 37 °C for 2–4 h; fluorescence screening was carried out using UV illumination at 365 nm to detect larvae inside tissues; larval extraction was performed using saline sedimentation followed by stereomicroscopic observation. Parasites were preserved in 70% ethanol and identified morphologically using standard taxonomic identification keys.

Variables and Measurements

Prevalence was calculated as the proportion of infected fish relative to the total number of examined fish (%). Infection intensity was defined as the mean number of parasites per infected fish. When multiple parasite species were found in a single host, the prevalence of each species was calculated separately based on species-specific parasite counts rather than pooled parasite totals to avoid overestimation.

Data Analysis

Data were analyzed descriptively and expressed as prevalence (%) and mean intensity (individuals per infected fish). Comparisons between sampling locations were performed using chi-square tests for prevalence and Mann-Whitney U tests for infection intensity. All statistical outputs including p-values, effect sizes, and 95% confidence intervals—are now reported in the Results section. The significance level was set at $p < 0.05$ using SPSS software (IBM Corp., Armonk, NY, USA).

Ethical Considerations

All procedures followed institutional guidelines for animal handling and welfare. No fish were intentionally captured from the wild for the purpose of this study; all specimens were obtained exclusively from routine commercial landings, and no additional harm was inflicted beyond necropsy. Under Indonesian research regulations, post-mortem parasitological examination of commercially landed fish does not require an environmental or wildlife sampling permit; therefore, no permit number applies.

Results and Discussion

Fish Sampling

Fish sampling was conducted at two major landing sites representing distinct ecological regions: Bawean Bay, Gresik (Java Sea), for specimens landed at Paciran Fish Landing Site (TPI), and Prigi Bay, Trenggalek (Indian Ocean), for specimens landed at Tamperan TPI. Both areas fall within the Indonesian Fisheries Management Areas and are known as productive coastal ecosystems where ribbonfish (Trichiuridae), together with various demersal and pelagic fishes, are commonly landed (6).

Paciran Fish Landing Site (Lamongan)

Fishermen operating at the Fish Landing Site (TPI), Lamongan, generally conduct daily fishing trips in nearby waters, with ribbonfish (*Trichiuridae*) often caught as bycatch in Bawean Bay. During non-peak seasons, catches of ribbonfish per vessel range between 5–10 kg, whereas in peak seasons yields can reach up to 50 kg per trip. In this study, a total of 36 individuals (≈ 5 kg) were sampled, with body weights predominantly in the 100–200 g class and total lengths mostly exceeding 50 cm, consistent with the length and weight distributions presented in **Table 1**.

Besides ribbonfish, other landed species included small pelagic fishes such as sardines (*Sardinella* spp.), mackerel (*Scomberomorus* spp.), tuna (*Thunnus* spp.), skipjack (*Katsuwonus pelamis*), and scads (*Decapterus* spp.), as well as crustaceans including crabs, swimming crabs, shrimp, shellfish, and squids (7). According to Fisheries Management Area (WPP NRI) 712, which covers the Java Sea, major fishing grounds are located around the Karimunjawa Islands, Bawean Island, Masalembu Islands, and the eastern parts of Matasiri Island. This region is highly productive, supporting small and large pelagic fish, demersal fish, and reef fish, a condition that also provides diverse potential intermediate and paratenic hosts for fish parasites (6).

The Bawean Bay fishing ground, where ribbonfish landed at Paciran are caught, is a productive coastal area characterized by sandy-muddy substrates and relatively shallow waters (<50 m), which provide suitable habitat for demersal species, including Trichiuridae. The region supports diverse assemblages of pelagic and demersal fishes and generally meets national seawater quality standards, which may influence the structure of local fish communities and parasite transmission dynamics (6–9).

Tamperan Fish Landing Site (Pacitan)

At the Tamperan Fish Landing Site (TPI), Pacitan, ribbonfish (Trichiuridae) are harvested using both small and medium-sized vessels. During the sampling period in June, which coincided with the non-peak season, a total of 20 individuals (≈ 5 kg) were collected, with most specimens falling within the 200–300 g and >300 g weight classes and total lengths predominantly between 60 and 80 cm, in accordance with the distributions summarized in **Table 1**.

Prigi Bay supports a diverse fishery, including large pelagic species such as *Euthynnus affinis*, *Thunnus obesus*, *Thunnus alalunga*, *Makaira nigricans*, *Katsuwonus pelamis*, *Auxis rochei*, and *Auxis thazard*. Small pelagic species such as *Scomber australasicus*, *Sardinella lemuru*, *Sphyrna barracuda*, *Selar crumenophthalmus*, *Decapterus kurroides*, and *Rastrelliger kanagurta* are also abundant, alongside demersal fishes including *Trichiurus lepturus*, *Lutjanus johnii*, *Lates calcarifer*, *Leiognathus* spp., and *Priacanthus* spp.

Table 1. Length and weight characteristics of Ribbonfish (Trichiuridae) collected from Paciran (Java Sea) and Tamperan (Indian Ocean).

Characteristics	Category	Average Number of Fish	
		Paciran (Java Sea)	Tamperan (Indian Ocean)
Length Class (cm)	< 50	45.31 ± 4.09	67.57 ± 1.98
	> 50	57.27 ± 5.54	73.42 ± 2.73
Weight Class (g)	< 100	80.95 ± 15.52	185.70 ± 15.98
	100–200	128.20 ± 27.75	245.93 ± 24.30
	> 200	205.00 ± 7.07	335.30 ± 23.62

**Figure 1.** Ribbonfish (Trichiuridae) specimens collected for parasitological examination and digestive tract contents. Source: Personal documentation, 2022.

The bay is relatively shallow (5–70 m) with muddy substrates and moderate sediment loads, conditions favorable for ribbonfish (10). Water quality in Prigi Bay remains within the standards of the Indonesian Ministry of Environment Decree No. 51/2004, with reported ranges of temperature (25.12–27.54 °C), salinity (33.75–34.54 ppt), and dissolved oxygen (6.73–8.87 ppm) (11). Variability in salinity and oxygen levels is influenced by depth, land-based inputs, and seasonal conditions. Environmental fluctuations such as reduced salinity, oxygen depletion, or pH decline can negatively affect marine organisms by disrupting respiration, growth, and survival (12). Poor water quality has further been associated with higher disease susceptibility in marine fish populations (13).

Endoparasites

A total of 56 ribbonfish were examined, consisting of 36 individuals from Paciran (Lamongan) and 20 individuals from Tamperan (Pacitan). The prevalence of endoparasite infection was 19.4% (7/36) in Paciran and 35.0% (7/20) in Tamperan. Infection intensity remained relatively low in both locations, with 1.3 individuals per infected fish in Paciran and

1.9 individuals per infected fish in Tamperan. Two nematode species, *Anisakis* sp. and *Camallanus* sp., were detected in the gastrointestinal tract and muscle tissues. The results indicate that parasitic infection was more frequent in ribbonfish landed at Tamperan, although the overall parasitic burden was low.

Endoparasites are internal parasites commonly found in the gastrointestinal tract and visceral organs of fish, including the stomach, intestine, liver, and swim bladder. In ribbonfish, infections are often associated with food intake, which facilitates parasite transmission. Major groups of fish endoparasites include protozoa, digeneans, acanthocephalans, nematodes, and parasitic crustaceans (14). These infections can cause significant economic losses due to mortality, reduced growth, impaired condition, and increased susceptibility to secondary infections by fungi, bacteria, or viruses.

Clinical signs in infected fish generally include metabolic disorders, organ damage (particularly in the stomach and intestine), impaired growth, and increased mortality. Species frequently reported from ribbonfish include *Eustrongylides* sp. and *Anisakis* sp. in the stomach, and *Acanthocephalus* sp., *Camallanus* sp., *Ascaris* sp., and *Trichuris trichiura* in the intestine (15). Other nematodes, such as *Capillaria* sp. and acanthocephalans like *Rhadinorhynchus* sp. have also been documented (16).

Parasitic infections in fish are determined by the interplay of three major factors: the host, the parasite, and the environment. A well-functioning immune system enables fish to resist parasitic invasions, whereas poor environmental conditions can exacerbate infection risk. High organic matter, oxygen imbalance, and interspecific competition favor parasite persistence. Furthermore, inadequate water quality management and unhygienic feed, such as the use of untreated small fish as natural feed, have been reported to increase infection prevalence (16). Examples of ribbonfish specimens collected for parasitological examination are shown in **Figure 1A**.

The presence of parasites in fish is frequently associated with suboptimal water quality and other environmental stressors, which may reduce host condition and increase susceptibility to infection. Infected individuals often exhibit impaired growth and reduced body condition as parasites utilize nutrients from the gastrointestinal tract and other internal organs. However, in the present study, the relationship between host body weight and parasite burden was not formally tested using correlation analysis, and any apparent association should therefore be interpreted as suggestive rather than causative. Parasitological examination was performed using both external and internal inspections. External assessment included microscopic observation of fins, gills, and skin, while internal organs were examined following necropsy. Dissection was conducted using a scalpel from the abdominal cavity toward the pectoral fin, dorsal fin, and head. The stomach, intestine, liver, kidney, and muscle were removed, rinsed with physiological saline, and examined under a microscope. Gastrointestinal contents were emptied into Petri dishes to facilitate parasite identification.

Ribbonfish, being carnivorous, often prey on small fish and crustaceans, which serve as vectors for parasite transmission. In specimens collected from Prigi Bay, Trenggalek, small fish and crustaceans were found in the digestive tract, suggesting higher exposure to parasite sources. In contrast, specimens from Bawean waters,

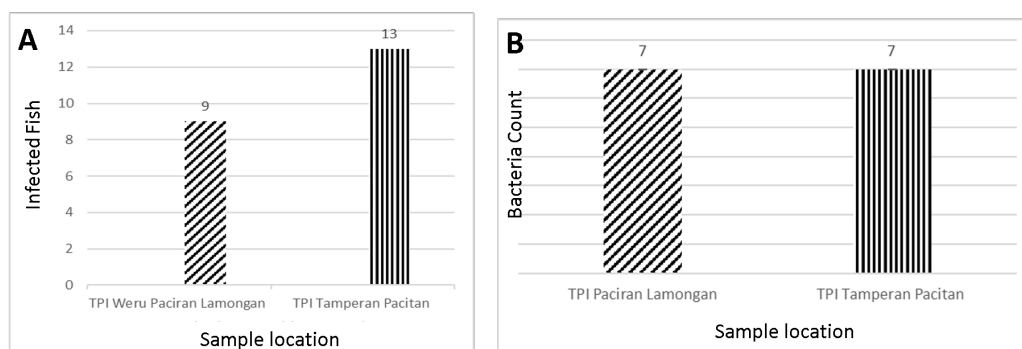


Figure 2. Endoparasite abundance (A) and number of infected Ribbonfish at two landing sites (B).

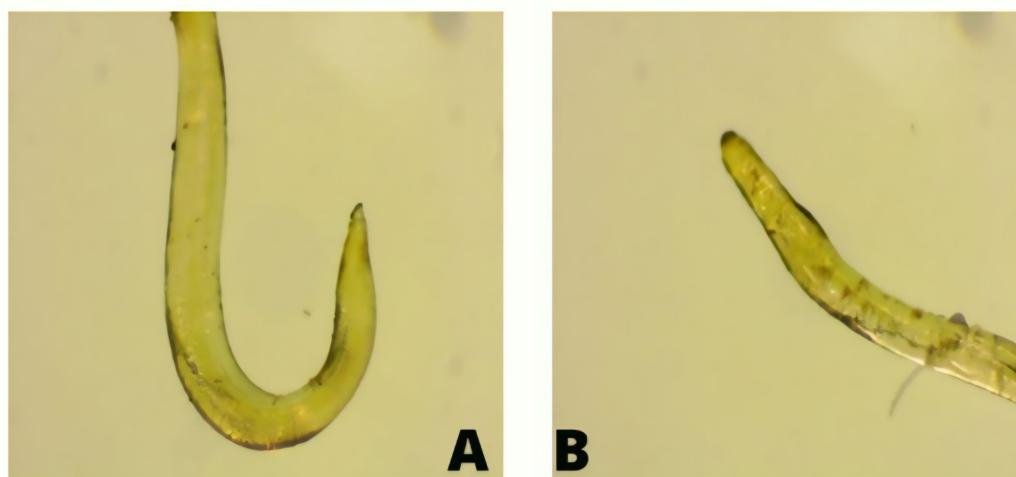


Figure 3. Morphological features of *Anisakis* sp. Note: (A) anterior and (B) posterior.

Gresik, exhibited smaller body weights and lacked prey remains in their intestines. This dietary difference may influence parasite prevalence and intensity. An example of prey items retrieved from the digestive tract is shown in **Figure 1B**.

The study identified two nematode endoparasites, *Anisakis* sp. and *Camallanus* sp., in ribbonfish, localized in the intestine, stomach, and muscle tissues. **Figure 2** presents the combined results of parasite abundance and the number of infected hosts across both landing sites. A total of 7 out of 36 fish from TPI Paciran Lamongan (19.4%) and 7 out of 20 fish from TPI Tamperan Pacitan (35.0%) were infected, yielding 14 infected individuals from 56 specimens examined. The higher prevalence and intensity observed in ribbonfish landed at Tamperan may be related to differences in feeding ecology and habitat use at Prigi Bay, where specimens more frequently contained small fish and crustaceans in their digestive tracts that can act as intermediate or paratenic hosts. This pattern suggests a potential link between trophic position and parasite exposure; however, because no formal statistical modeling of these relationships was conducted, the association remains indicative and should not be interpreted as demonstrating a direct causal effect of body size on infection risk.

Anisakis sp.

One of the endoparasites identified in ribbonfish was *Anisakis* sp. The morphological features of this nematode are

illustrated in **Figure 3**, showing both the anterior and posterior body regions.

Anisakis sp. is a nematode parasite characterized by an elongated cylindrical body, transparent in color, with a tapered posterior end. This parasite exhibits sexual dimorphism, with females possessing paired oviducts, ovaries, and a uterus, while males contain a single reproductive tract with testes, vas deferens, spicules, and a cloaca (17). As a zoonotic parasite, *Anisakis* sp. is capable of infecting marine mammals, fish, and occasionally humans.

In ribbonfish, *Anisakis* sp. penetrates the gastrointestinal tract and can migrate to other internal organs such as the stomach, intestines, and liver, where nutrient availability supports its survival. Heavy infections may reduce the host's body weight and overall condition. The life cycle begins when eggs are excreted in the feces of marine mammals, hatching into first-stage larvae (L1) in the water. After successive molts, free-swimming second-stage larvae (L2) are ingested by crustaceans, developing into third-stage larvae (L3). These larvae are then transmitted to fish as intermediate or paratenic hosts and finally reach adulthood in marine mammals. Larvae are inactivated at temperatures above 60 °C or below 0 °C (18).

Beyond ribbonfish, *Anisakis* sp. has also been reported in mackerel (*Rastrelliger* sp.), tuna (*Euthynnus* sp.), snapper (*Lutjanus* sp.), and grouper, as well as cephalopods such as squid (19). This wide host range reflects the complex life cycle of *Anisakis* sp. and its ability to persist across multiple

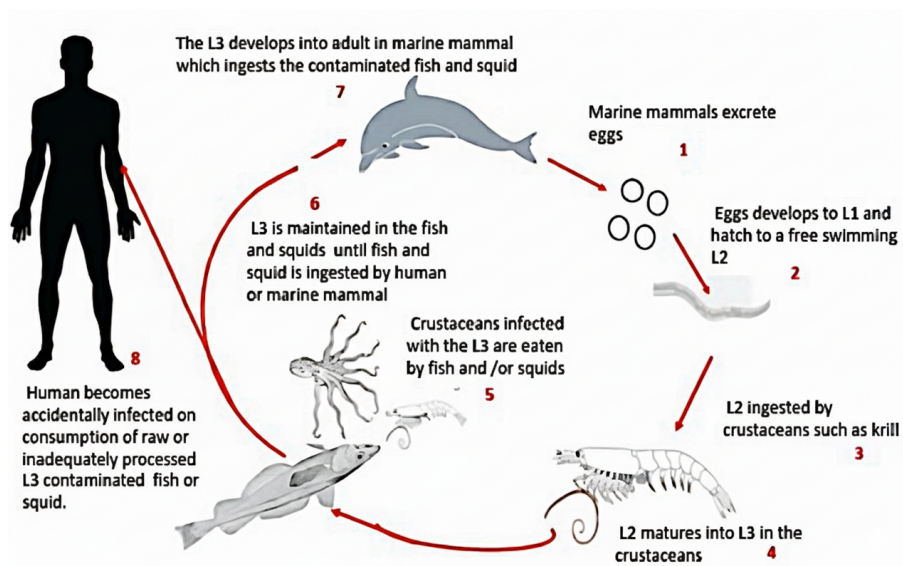


Figure 4. Transmission process of *Anisakis* sp. from marine hosts to human.

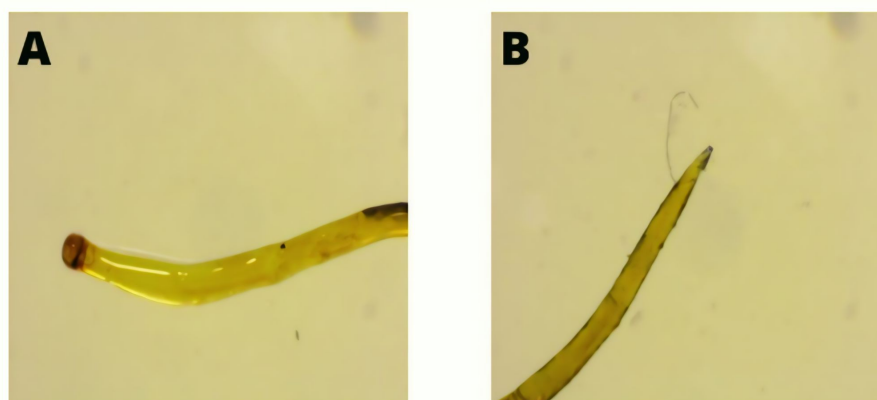


Figure 5. Morphology of *Camallanus* sp. Note: (A) anterior (head) and (B) posterior (tail).

trophic levels within marine ecosystems. Other zoonotic anisakid nematodes include *Pseudoterranova*, *Hysterothylacium*, *Gnathostoma spinigerum*, and *Contracaecum*, all of which are known to infect a wide range of marine and freshwater hosts and have been implicated in human parasitic infections. Transmission to humans typically occurs through the consumption of raw or undercooked seafood containing viable infective larvae. Once ingested, these larvae may invade the gastrointestinal tract, triggering clinical manifestations ranging from mild abdominal discomfort to severe gastrointestinal symptoms and allergic reactions. In certain cases, larval penetration and persistence may provoke inflammatory responses or hypersensitivity reactions, thereby exacerbating clinical severity. Consequently, the presence of zoonotic anisakid nematodes in seafood poses a significant risk for human anisakiasis and underscores the importance of proper seafood handling, processing, and cooking practices to reduce the risk of infection (18). The transmission mechanism of *Anisakis* sp. within the food web is illustrated in **Figure 4**.

The life cycle of *Anisakis* sp. begins when marine mammals release eggs through feces, which hatch into first-stage larvae (L1) in seawater. These larvae develop into free-

swimming L2 and are ingested by small fish or crustaceans, where they transform into infective third-stage larvae (L3). Larger fish and cephalopods become paratenic hosts by preying on these organisms, allowing the larvae to accumulate within their tissues. Humans and marine mammals are infected when consuming raw or undercooked seafood containing L3 larvae.

Infected fish may exhibit reduced body weight, gastrointestinal swelling, and impaired nutrient absorption. In humans, anisakiasis manifests with nausea, diarrhea, abdominal pain, allergic reactions, and in severe cases, eosinophilic granuloma or intestinal perforation (20).

Human cases are frequently reported in countries with high raw seafood consumption, such as Japan and parts of Europe. For instance, consumption of raw squid (sashimi, sushi) or inadequately processed anchovies (*Engraulis encrasicolus*) has been linked to outbreaks of anisakiasis, particularly caused by *Anisakis pegreffii* (18, 19).

Camallanus sp.

The second endoparasite identified in ribbonfish was *Camallanus* sp., with its morphology presented in **Figure 5**.

Camallanus sp. infects the intestine, pylorus, and caecum of fish, where it attaches to the mucosal lining and utilizes

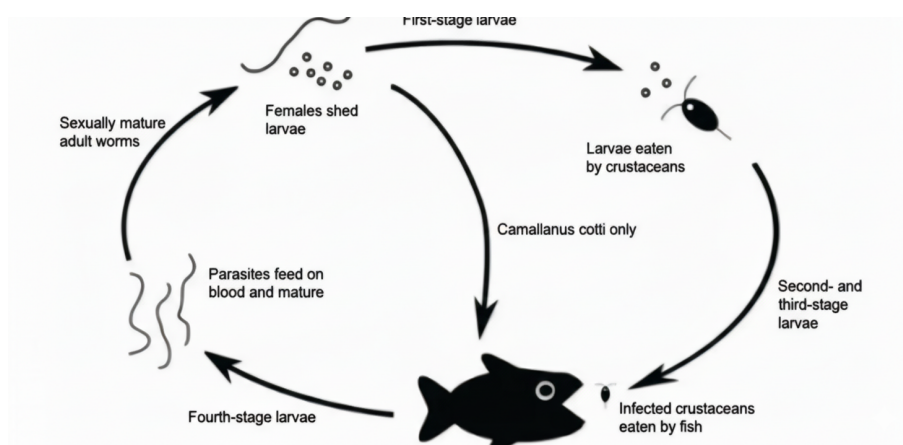


Figure 6. Life cycle of *Camallanus* sp.

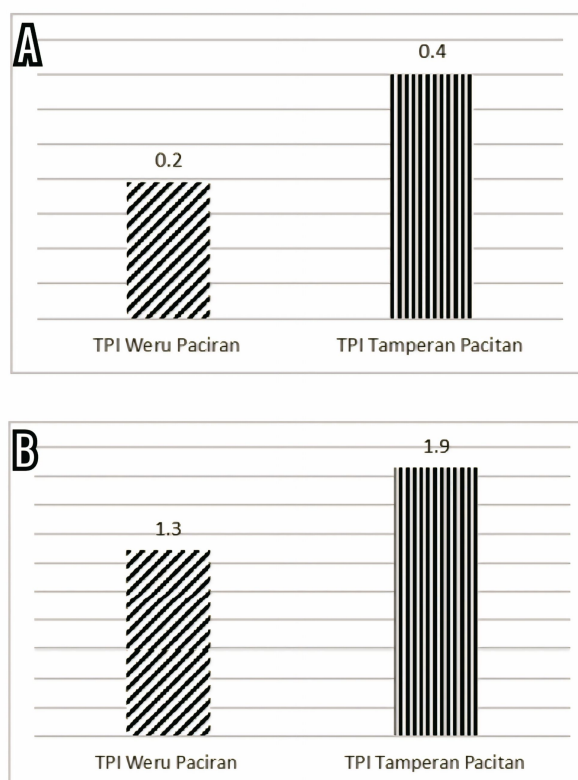


Figure 7. Prevalence (A) and intensity (B) of endoparasite infection.

host nutrients for growth and reproduction. Taxonomically, it belongs to the phylum Nematelminthes, class Nematoda, order Camallanoidea, family Camallaninae, and genus *Camallanus*. The parasite is approximately 10 mm in length and is characterized by a cylindrical body covered by a cuticle extending from the anterior to the posterior region (mucron). The anterior end is rounded, whereas the posterior end is tapered, features that are commonly used as key diagnostic characters in morphological identification (21). The life cycle of *Camallanus* sp. is illustrated in Figure 6.

The life cycle begins with adult females releasing larvae into the host's intestine. The larvae are expelled into the water, where they develop into the second-stage larvae (L2). These are ingested by crustaceans, serving as intermediate hosts, and further develop into infective third-stage larvae (L3). Once consumed by fish, the larvae mature into adults in

the intestine. The larvae are capable of surviving in water for up to 12 days (22).

Although *Camallanus* sp. is not zoonotic like *Anisakis* sp., it still causes significant harm to fish health. Clinical signs include intestinal and anal hemorrhage due to mucosal damage, anemia, deformities, and, in severe cases, mortality (23). Worms may protrude from the anus, and heavy infestations can permanently damage intestinal tissues (24).

Prevalence and Intensity of Parasites

The prevalence of endoparasite infection in ribbonfish and infection intensity is presented in Figure 7.

The prevalence of infection was 19.4% in ribbonfish landed at TPI Paciran (Lamongan) and 35.0% in those landed at TPI Tamperan (Pacitan). Infection intensity was 1.3 ind/individual in Paciran and 1.9 ind/individual in Tamperan,

both categorized as low-level infections. Chi-square and Mann-Whitney U tests did not detect statistically significant differences in either prevalence or infection intensity between the two landing sites ($p > 0.05$), and therefore the results are mainly interpreted on the basis of descriptive patterns.

From Paciran, a total of 36 ribbonfish were examined, with 7 individuals infected by *Anisakis* sp. (body weight: 40–100 g; length: 40–50 cm). From Tamperan, 20 individuals were sampled, with 7 fish infected by *Anisakis* sp. and *Camallanus* sp. (body weight: 100–400 g; length: 60–80 cm).

Parasite distribution is influenced by environmental conditions, host size, age, sex, and other ecological factors (24). The higher prevalence and intensity in Tamperan samples may be associated with the larger body size of ribbonfish from Prigi Bay, which frequently contained small fish and crustaceans in their digestive tracts, serving as intermediate hosts.

Although infection levels in this study were relatively low compared to some other reports, they remain ecologically relevant. Prevalence and intensity values were lower compared to ribbonfish sampled from Cilacap, where infection reached 53.33% (25). Parasite infections are known to reduce appetite, growth, and metabolism, which may ultimately result in mortality (Nofyan, 2015) (26). However, host body weight alone is not a determining factor, as environmental conditions also play a crucial role in shaping infection dynamics (25).

Conclusion

This study confirmed the occurrence of two nematode endoparasites, *Anisakis* sp. and *Camallanus* sp., infecting ribbonfish (*Trichiurus lepturus*) from Paciran and Tamperan landing sites. Although prevalence (19.4–35.0%) and infection intensity (1.3–1.9 ind/individual) were classified as low, the detection of zoonotic *Anisakis* sp. highlights the potential public health relevance of endoparasites in commercially important marine fish. Interpretation of the findings should consider several limitations, including the small sample size, the use of purposive rather than random sampling, the absence of molecular confirmation for parasite identification, and the lack of seasonal replication, which may have affected the generalizability of infection patterns. Future studies are recommended to incorporate longitudinal sampling across fishing seasons, molecular-level species validation, and expanded sampling coverage to better assess spatial and temporal variations in parasite transmission dynamics and evaluate associated risks for fisheries and human consumers.

Declarations

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Contribution: Data Curation, Formal analysis, Visualization, Writing - Original Draft, Writing - Review & Editing.

Conflict of Interest

The author declare no conflicting interest.

Data Availability

All data generated or analyzed during this study are included in this published article.

Ethics Statement

Ethical approval was not required for this study.

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Additional Information

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